

CLAIMS

1. A pasting method of pasting a thin plate to a planar member, said pasting method comprising the steps of:

holding the thin plate and the planar member vertically opposite to each other with their joining surfaces extended in high flatness respectively on first and second holding members capable of moving in directions along an X-axis, a Y-axis and a Z-axis and of turning in a θ -direction relative to each other;

pouring a liquid crystal wax onto the thin plate when the thin plate is disposed below the planar member or onto the planar member when the planar member is disposed below the thin plate;

heating the liquid crystal wax to keep the liquid crystal wax in a liquid phase;

spreading the liquid-phase liquid crystal wax in a liquid-phase liquid crystal wax layer over the surfaces of the thin plate and the planar member by holding the liquid-phase liquid crystal wax layer between the thin plate and the planar member and moving the thin plate and the planar member relative to each other;

adjusting the thickness of the liquid-phase liquid crystal wax layer to a predetermined thickness; and

cooling the liquid-phase liquid crystal wax layer to solidify the liquid crystal wax layer.

2. A pasting method of pasting a thin plate to a planar member, said pasting method comprising the steps of:

holding the thin plate and the planar member vertically opposite to each other with their joining surfaces extended in high flatness respectively on first and second holding members capable of moving in directions along an X-axis, a Y-axis and a Z-axis and of turning in a θ -direction relative to each other;

pouring a liquid crystal wax onto the thin plate when the thin plate is disposed below the planar member or onto the planar member when the planar member is disposed below the thin plate;

aligning the thin plate and the planar member with each other on the basis of respective recognized positions of the thin plate and the planar member;

heating the liquid crystal wax to keep the liquid crystal wax in a liquid phase;

spreading the liquid-phase liquid crystal wax in a liquid-phase liquid crystal wax layer over the surfaces of the thin plate and the planar member by holding the liquid-phase liquid crystal wax layer between the thin plate and the planar member and moving the thin plate and the planar member relative to each other;

adjusting the thickness of the liquid-phase liquid crystal wax layer to a predetermined thickness; and

cooling the liquid-phase liquid crystal wax layer to solidify the liquid crystal wax layer.

3. The pasting method according to claim 2, wherein the step of aligning the thin plate and the planar member with each other adjusts the positional relation between the thin plate and the planar member in a plane and parallelism between the thin plate and the planar member.

4. The pasting method according to claim 3, wherein parallelism between the thin plate and the planar member is adjusted by using piezoelectric elements.

5. The pasting method according to any one of claims 2 to 4, wherein the step of aligning the thin plate and the planar member with each other forms respective images of the thin plate held by the first holding member and the planar member held by the second holding member, recognizes the respective positions of the thin plate and the planar member on the basis of the images, and aligns the thin plate and the planar member with each other on the basis of information about the recognized positions of the thin plate and the planar member.

6. The pasting method according to any one of claims 1 to 5, wherein the first holding member holds the thin plate by suction.

7. The pasting method according to any one of claims 1 to 6, wherein the first holding member holds the thin plate with a tensile stress induced in the thin plate in a plane containing the thin plate.

8. The pasting method according to any one of claims 1 to

7, wherein the second holding member holds the planar member by suction.

9. The pasting method according to any one of claims 1 to 8, wherein the thickness of the liquid crystal wax layer formed between the thin plate and the planar member is adjusted by adjusting the thickness of the space between the thin plate and the planar member.

10. The pasting method according to any one of claims 1 to 8, wherein the thickness of the liquid crystal wax layer formed between the thin plate and the planar member is adjusted to the diameter of particles by mixing the particles in the liquid crystal wax forming the liquid crystal wax layer and moving the first and the second holding member so as to hold the particles between the thin plate and the planar member.

11. The pasting method according to any one of claims 1 to 8, wherein, when a three-dimensional pattern is formed on the thin plate, the thickness of the liquid crystal wax layer formed between the thin plate and the planar member is adjusted to the thickness of the three-dimensional pattern by moving the first and the second holding member so as to bring the free surface of the three-dimensional pattern into contact with the planar member.

12. The pasting method according to any one of claims 1 to 11, wherein materials respectively forming the thin plate and the planar member have nearly equal coefficients of thermal expansion, respectively.

13. The pasting method according to claim 12, wherein the thin plate is a silicon wafer, and the planar member is a silicon wafer or a glass substrate.

14. The pasting method according to claim 12, wherein the thin plate is a metal foil and the planar member is a metal plate.

15. A pasting apparatus for pasting a thin plate to a planar member, said pasting apparatus comprising:

first and second holding members respectively for holding the thin plate and the planar member opposite to each other so that respective joining surfaces of the thin plate and the planar member face each other;

first and second holding mechanisms respectively for operating the first and the second holding member to hold the thin plate and the planar member flat respectively on the first and the second holding member;

a moving mechanism for moving the first and the second holding member relative to each other in directions along an X-axis, a Y-axis and a Z-axis and turning the same in a θ -direction;

a liquid crystal wax pouring mechanism for pouring a liquid crystal wax onto the thin plate when the thin plate is disposed below the planar member or onto the planar member when the planar member is disposed below the thin plate;

heating means incorporated into at least either of the first and the second holding member;

cooling means incorporated into at least either of the first and the second holding member; and

a control mechanism for spreading the liquid crystal wax liquefied by the heating means in a liquid-phase liquid crystal wax layer over the joining surfaces of the thin plate and the planar member by holding the liquid-phase liquid crystal wax layer between the thin plate and the planar member and moving the thin plate and the planar member relative to each other.

16. The pasting apparatus according to claim 15, wherein the thickness of the liquid crystal wax layer is adjusted through the adjustment of the thickness of the space between the thin plate and the planar member by moving the first and the second holding member relative to each other by the moving mechanism.

17. A pasting apparatus for pasting a thin plate to a planar member, said pasting apparatus comprising:

first and second holding members respectively for holding the thin plate and the planar member opposite to each other with the respective joining surfaces of thereof facing each other;

first and second holding mechanisms respectively for making the first and the second holding member hold the thin plate and the planar member flat, respectively;

a moving mechanism for moving the first and the second holding member relative to each other in directions along an X-axis,

a Y-axis, a Z-axis and turning the same in a θ -direction;

a position recognizing mechanism for recognizing the respective positions of the thin plate and the planar member;

a parallelism adjusting mechanism for adjusting parallelism between the thin plate and the planar member;

a liquid crystal wax pouring mechanism for pouring a liquid crystal wax onto the thin plate when the thin plate is disposed below the planar member or onto the planar member when the planar member is disposed below the thin plate;

heating means incorporated into at least either of the first and the second holding member;

cooling means incorporated into at least either of the first and the second holding member; and

a control means for controlling the parallelism adjusting mechanism and the moving mechanism;

wherein the control means controls the parallelism adjusting mechanism and the moving mechanism on the basis of information provided by the position recognizing mechanism to position the thin plate and the planar member in a predetermined positional relation, and controls the moving mechanism in a state where the liquid crystal wax is held between the thin plate and the planar member to move the thin plate and the planar member relative to each other to spread the liquid crystal wax in a liquid crystal wax layer over the surfaces of the thin plate and the planar member.

18. The pasting apparatus according to claim 17, wherein the control means controls an operation of the moving mechanism for moving the thin plate and the planar member relative to each other in a direction along the Z-axis to adjust the thickness of the space between the thin plate and the planar member.

19. The pasting apparatus according to claim 17 or claim 18, wherein the parallelism adjusting mechanism includes piezoelectric elements.

20. The pasting apparatus according to any one of claims 17 to 19, wherein the position recognizing mechanism includes a first camera for forming an image of the thin plate held by the first holding member, and a second camera for forming an image of the

planar member held by the second holding member; and recognizes the respective positions of the thin plate and the planar member on the basis of the images formed by the first and the second camera.

21. The pasting apparatus according to any one of claims 15 to 20, wherein the first holding member holds the thin plate by suction.

22. The pasting apparatus according to any one of claims 15 to 21, wherein the first holding member holds the thin plate with a tensile stress induced in the thin plate in a plane containing the thin plate.

23. The pasting apparatus according to any one of claims 15 to 22, wherein the second holding member holds the planar member by suction.

24. A pasting method of pasting together two thin metal plates, said pasting method comprising the steps of:

individually and continuously supplying the two thin metal plates;

guiding the two thin metal plates downward with the two thin metal plates spaced from each other by a space of a predetermined thickness;

pouring down a liquid crystal wax into the space between the two thin metal plates;

pressing the two thin metal plates holding the liquid crystal wax and moving downward to paste the two thin metal plates together;

solidifying the liquid crystal wax by cooling the liquid crystal wax held between the two thin metal plates after the two thin metal plates have been pasted together in a laminated structure; and

cutting the laminated structure.

25. A pasting apparatus for pasting together two thin metal plates, said pasting apparatus comprising:

two supply rolls for individually and continuously supplying the two thin metal plates;

guide rollers for guiding the two thin metal plates downward

with the two thin metal plates spaced from each other by a space of a predetermined thickness;

a liquid-phase liquid crystal wax pouring mechanism for pouring down a liquid-phase liquid crystal wax into the space between the two thin metal plates;

pressure rollers for pressing the two thin metal plates to paste together the two thin metal plates holding the liquid crystal wax and moving downward;

heating means for heating the two thin metal plates being pressed between the pressure rollers;

cooling means for cooling the liquid crystal wax held between the two thin metal plates after the two thin metal plates have been pasted together in a laminated structure to solidify the liquid crystal wax; and

cutting means for cutting the laminated structure.